PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5: E21B 37/00, 21/00

A1

(11) International Publication Number: WO 93/07358

(43) International Publication Date: 15 April 1993 (15.04.93)

(21) International Application Number: PCT/NO92/00157

(22) International Filing Date: 22 September 1992 (22.09.92)

(30) Priority data:
913823 30 September 1991 (30.09.91) NO

(71) Applicant *(for all designated States except US)*: WEPCO AS [NO/NO]; P.O. Box 5015, Dusavik, N-4004 Stavanger (NO).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)* : EIANE, Dag [NO/NO]; N-4158 Bru (NO). NILSEN, Magne, Petter [NO/NO]; Margrethesg. 4, N-4042 Hafrsfjord (NO).

(74) Agent: HÅMSØ PATENTBYRÅ; P.O. Box 171, N-4301 Sandnes (NO).

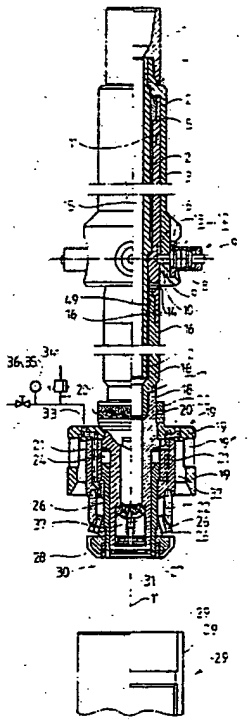
(81) Designated States: AT, AU, BB, BG, BR, CA, CH, CS, DE, DK, ES, FI, GB, HU, JP, KP, KR, LK, LU, MG, MN, MW, NL, NO, PL, RO, RU, SD, SE, US.

Published
With international search report.

(54) Title: CIRCULATION EQUIPMENT

(57) Abstract

The invention relates to a circulation equipment for the purging of predrilled oil and gas wells upon setting of casings and conductor pipes. The equipment may be designed to be suspended from the top drive of a derrick. Thereby, one has aimed at establishing a fluid-tight, easily releasable interconnection between circulation equipment and casing/conductor pipe (29) to be circulated in connection with setting, without the use of threads. The circulation equipment having the form of an elongated pipe having a through-going bore (15), carries at the lower end thereof (with respect to the position of use) a tool head (19) exhibiting a downwardly open annulus (32) for the accommodation of the coupling piece (29') of said casing/conductor pipe (29) and, within the area of said annulus (32), a radially expandable annular packing element (22) which in expanded condition, with said pipe coupling piece (29') situated within the annulus (32), rests itself sealingly against the inner surface of the pipe coupling piece (29').



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CS	Czechoslovakia
CZ	Czech Republic
DE	Germany
DK	Denmark
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IT	Italy
JP	Japan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
LI	Liechtenstein
LK	Sri Lanka
LU	Luxembourg
MC	Monaco
MG	Madagascar
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SK	Slovak Republic
SN	Senegal
SU	Soviet Union
TD	Chad
TG	Togo
UA	Ukraine
US	United States of America
VN	Viet Nam

CIRCULATION EQUIPMENT

This invention relates to circulation equipment for purging predrilled oil and gas wells upon the placement of casing and conductor pipes, more particularly a tool suspendable from the topdrive of a derrick during the placement and circulation of casing and conductor pipes. Such pipes may e.g. have dimensions corresponding to an outer diameter of 7 inches or more.

The circulation or purge medium, respectively, may e.g. consist of cement, mud, diesel oil or water.

During and after the predrilling of a subsea well, rock pieces and the like will often fall down from the wall defining the bore hole, constituting obstacles whenever casing and conductor pipes are set. This is especially prevailing with deviated and horizontal wells, but occurs likewise with more or less vertical wells wherein pieces of rock, etc., become stuck to uneven portions of the wall defining the bore hole.

Such undesired rock piece accumulations must be purged away in order to clean the bore hole where said pipe is to be set. Such a purging taking place through the pipe to be set, is preferably effected upon the placement of the first external pipe, which may have a length of the order of

several hundred meters, e.g. 2000 meters. The individual casing or conductor pipes, respectively, are joined at the drilling platform whenever they are pushed/pressed down into the the formation during an operation designated setting.

Today, it is very laborous and time-consuming to connect such a circulation equipment/tool for the purging-through of casing/conductor pipe.

Prior art technique comprises screwing of a threaded circulation/purge liquid supply socket onto the casing/ conductor pipe in question. Such a threaded socket must be screwed onto every individual pipe to be purged through. The screwing/unscrewing operation itself requires two-four men, dependent on rig equipment. With this prior art technique, a risk for the breaking of the connector of the pipe exists, and problems often arise to loosen the connector of the pipe after use. The method is very time-consuming.

Moreover, such a screwable/unscrewable circulation/purge liquid supply socket is often not utilized prior to the moment when casing/conductor pipe has become wedged within the bore hole and, then, the auxiliary operation may have been initiated too late to succeed with the pipe taking the actual position, so that the entire pipe length must be pulled up again before a new purging operation can be started. Another obvious disadvantage using a screwable/ unscrewable threaded socket having a supply of purge liquid is that casing/conductor pipe can not be pressed down into the bore hole while the socket is connected to the pipe.

Likewise, for said circulation/purging operation, heavy and unhandy equipment is known, requiring at least three men plus winch equipment for operation and manipulation. With the time-consuming manipulation operations, a risk for

damage on both equipment and pipe exists.

Not in any known method or device of the kind involved is it possible to perform purging of a predrilled well simultaneously with the placement of casing pipes. As mentioned above, the laborous and time-consuming interconnection between circulation equipment and casing/ conductor pipe represents a very substantial disadvantage. Previously known equipment does not allow that one positively press the casing/conductor pipe down during the purging process, but such a forced pressure actuation may be absolutely necessary when such pipes are to be forced into a portion of a predrilled well following an arcuate path.

The object of the present invention is to remedy defects, disadvantages and application limitations of prior art technique and, thus, provide a circulation equipment/tool of the introductorily defined kind and for the previously defined object wherein the equipment/tool may be coupled sealingly and easily releasably together with the connector of the casing/coinductor pipe without the use of threads, and wherein the interconnection area optimaly functions as a shock absorber.

According to the present invention, said object is realized through designing a circulation equipment in accordance with the following main claim preamble such that it exhibits the features comprises by the characterizing part of the main claim.

Such a circulation equipment is intended to be mounted below the top drive of the derrick before the setting of casing pipes is started, wherein the circulation equipment is presupposed operated/controlled by the driller from his panel, no manual work being employed.

The circulation equipment according to the invention is considered used for purge liquid circulation of such pipes also when said wedging problem is not expected to arise (this contrary to conventional equipment which is presupposed used when said problems acutally have arisen; problems very often due to lacking purging in advance).

Such a purging in advance enabled through the arrangement of the circulation equipment according to the invention, acts thus preventive and involes also in this respect substantial time-savings.

The circulation operations enabled by the equipment according to the invention may be incorporated into a running process for the setting of the pipes in question, thereby securing a better continuity than conventional equipment allows.

The circulation equipment/tool according to the invention is designed especially with a view of excluding a leakage of circulation medium and purge liquid to the environment.

Further features, advantages and details of a circulation equipment according to the present invention will appear from the following specification in association with the following drawings as well as the claims.

Reference is made to the drawings, wherein:

Figures 1 and 2 half in side view/half in axial section show a circulation equipment according to the invention, broken lines being inserted, in that the views are not representative with regard to the axial length of the equipment (broken-away portions between said broken lines have, however, the same cross-sectional shape as the portions at the opposite side of the broken lines), in that

Figure 1 shows the equipment in a position of readiness in relation to a coaxially below positioned casing/conductor pipe, i.e. in an inactive position prior to the establishment of the interconnection with the pipe, while

Figure 2 shows the same equipment and pipe as in figure 1, yet with the equipment fluid-sealingly coupled to the top connector portion of the pipe;

Figure 3 and 4 show, on a larger scale, the lower portion of the equipment according to figures 1 and 2, the coupling head of the equipment occupying the same position as in figure 1 and figure 2, respectively.

In all figures of the drawings, identical reference numeral have throughout been used for similar parts.

First, reference is made to figures 1 and 2, the description of the individual parts included into a circulation equiment according to the invention starts with the uppermost part which is constituted by a connector denoted at the reference numeral 1.

The sleeve- or socket-shaped connector 1, the cross-sectional shape thereof appearing from the right half of figures 1 and 2 and which is not critical for the function of the connector 1, provided that it is connectable to the top drive of the derrick (not shown), involves the advantage through its design as separate part that the thread wearing then is limited to the connector 1 itself, which is easily replaceable, instead of propagating to more bulky parts of the circulation equipment/tool, causing more comprehensive replacement operations.

The lower, internally threaded portion of the connector 1 is screwed onto external threads on the upper portion of an

axially extending pipe 2 incorporated into a hydraulic double-acting telescopic cylinder 2,2',3 which, besides the pipe 2, comprises an inner pipe 2' concentrical and fixedly attached to the former, said concentrical pipes 2,2' defining therebetween an annulus for the displaceable accommodation of a third pipe 3.

Reference numeral 4 denotes a locking screw for the connector 1.

The hydraulic double-acting telescopic cylinder 2,2',3 serves to enable a restricted, defined extension/shortening of the axial extent of the circulation equipment/tool.

Ports 5 and 6 serve as outlet and inlet, respectively, for pressure oil whenever the telescopic cylinder 2,2',3 is extended, i.e, when the axially displacable pipe 3 is lowered from the position of figures 1 and 3 into the position shown in figures 2 and 4, and which exchange their functions when the pipe 3 is pulled upwards from the position shown in figures 2 and 4 into the position shown in figures 1 and 3, i.e. that the port 5 acts as inlet for pressure oil at the latter pipe displacement, the port 6 then acting as outlet for pressure oil.

In order to retain the axially displaceable pipe 3 of the hydraulic double-acting telescopic cylinder 2,2',3 in the two extreme positions of the latter, i.e. at maximum length and at minimum length, a locking device 7 has been arranged at an appropriate place with respect to the length of the displaceable pipe 3, said lacking device 7 exhibiting any suitable construction and function, provided that it is capable of locking the pipe 3 of the telescopic cylinder in each extreme position in such a way that the locking function may be released rapidly.

In the embodiment shown, the locking device 7 comprises a housing formed with e.g. four radial cylindres 7', distributed with an angular displacement of 90° around the axis 1' of the circulation equipment. Each cylinder 7' accommodates a locking piston 8 positioned between the ends of a piston rod, one part 9 thereof being guided in respective cylinder's 7' gable wall, the other piston rod part 9' constituting the actual locking means, adapted to engage lockingly into one (at a time) of two concentrical circumferential grooves 10,11 formed into the displaceable pipe 3 of the telescopic cylinder 2,2',3 and spaced axially, determining the axial extension/shortening of the telescopic cylinder 2,2',3.

In figure 1, the locking parts 9' of the locking pistons 8,9,9' are in engagement with the lower circumferential groove 10 of the pipe 3, corresponding to contracted telescoopic cylinder, said locking parts 9' in figure 2 being in engagement with the upper circumferential groove 11 of the pipe 3, corresoponding to extended telescopic cylinder.

The housing of the locking device 7 wherein the cylinders 7' are formed, is provided with pressure oil ports 12 and 13 incorporated into a conventional hydraulic circuitry (not shown). The locking device can only be released by means of control hydraulics, which represents in per se known technique with hydraulic locking devices. For cleaning/ lubrication of the inner parts of the telescopic cylinder, purge ports 14 have been formed into the pipe 3.

Said purging of the inner parts of the telescopic cylinder is effected by a driller and is performed periodically and subsequent to circulating corrosive medium or mud/concrete.

The elongated, tubular through-going bore of the circulation

equipment/tool for the passage of circulation/purge medium has, generally, been denoted by the reference numeral 15. It should be clear without saying that this bore 15 which is through-going from one axial end of the equipment/tool to the other, is built up through smaller, aligned axial bores of the individual parts of which the equipment/tool is composed and which, generally, are screwed together.

Thus, the axially displaceable pipe 3 of the hydraulic double-acting telescopic cylinder 2,2',3 has at the lower end thereof been screwed onto an extension or intermediate piece 16, a locking screw securing the interconnection between the pipe 3 and the intermediate piece being denoted at 16' . Another locking screw 17 serves to secure the establishment of the screw connection between the intermediate piece 16 and an end sleeve 18, which approximately extends down to the extreme end (the lower end) of a coupling head of the circulation equipment, said coupling head generally being denoted 19 and which is formed for fluid-sealed interconnection to a coupling portion of a casing/conductor pipe; an interconnection to be described further later on.

Practically at the intermediate portion of the sleeve 18, the sleeve is surrounded by a guiding jacket 19',19", which is attached to the sleeve 18 by means of a locking nut 20 having a locking or safety screw 20' . The guiding jacket 19',19" has a substantially L-shaped cross section, comprising an axial portion and a radial portion, denoted 19' and 19", respectively.

Within the axial portion 19' thereof, the guiding jacket 19',19" has been formed with a radially directed inspection window 19''', through which one visually may observe the upper edge of the coupling portion of e.g. a casing to be circulated/purged in connection with setting.

A cylinder ring 21 having a lower circumferential groove 21' for the accommodation of an attachment portion 22' of a packing element 22 (see especially figures 3 and 4) which is of particular importance for the realization of the invention, is anchored to the guide jacket 19',19" by means of bolts, not shown. Through the guide jacket 19',19" and the cylinder ring 21 corresponding channels 23,23' for pressure oil have been formed and which, in one position of a packing-actuating sleeve (to be closer described below) leed to a first annulus 24 and, with said packing-actuating sleeve in another position, to a second annulus 25.

First annulus 24 is radially defined between opposing mantle surfaces of end sleeve 18 and cylinder ring 21 and axially between a shoulder surface 18' at a flange portion of the end sleeve 18 and an opposing, upper gable surface 26' of a sleeve-shaped packing-actuating means 26, i.e. a means adapted to actuate the packing element 22 which is retained by the cylinder ring 21.

More specifically, the packing-actuating sleeve 26 is formed with an outwardly conically tapering portion 26" which, in the embodiment shown, is constituted by the mantle surface of a conical ring body 26''' screwed onto the sleeve 26, but the former might as well be formed integrally with the latter. Therefore, these two parts are given similar reference numerals.

The packing-actuating sleeve 26 is axially displaceably supported in an annulus radially defined between opposing mantle surfaces of end sleeve 18 and cylinder ring 21 and wherein said first and second annulus 24,25 are incorporated, the maximum axial displacement distance of the packing-actuating sleeve 26 being restricted by the above-mentioned shoulder portion 18' of the end sleeve 18 and the upper gable surface 26' of the actuating sleeve 26, and by a

downwardly facing shoulder surface (no reference numeral) of the actuating sleeve 26 and an opposing shoulder surface 21" of the cylinder ring 21, see figure 4.

To the packing-actuating sleeve 26-26''', below the actual packing-actuating means 26''', is screwed a downwardly conically tapering guide head 27 surrrounded by a rubber jacket 28, with which the tool head of the circulation equipment is guided into the coupling portion 29' of a casing/conductor pipe 29, through which circulation/purging is to be effected upon setting. A locking nut for the attachment of the guide head 27,28 to the packing-actuating sleeve 26 is indicated at the reference numeral 30, as well as being assigned a radially directed locking screw 31.

Radially between the cylinder ring 21 and the guide jacket 19',19" is left an annulus for the accommodation of a suitably long portion of the coupling piece of a casing/ conductor pipe to be purged by means of the circulation equipment according to the invention, in connection with setting.

When studying figures 1 and 3 of the drawings on the one hand and figures 2 and 4 on the other hand, it should appear without saying how the tool head 19 of the circulation equipment is coupled to the coupling piece 29' of e.g. a casing 29, establishing a fluid-tight interconnection between equipment and pipe. More particularly, the circulation equipment is lowered from the position shown in figures 1 and 3 into the coupling piece 29' of the pipe 29, during which operation the downwardly conically tapering guide head 27 with the rubber jacket 28 centralizes the tool head 19 of the circulation equipment i relation to the pipe 29,29' . The upper edge 29" of the pipe's 29 coupling piece 29' may be observed through the inspection window 19''' of the guide jacket 19',19", in

order to secure that the position of the packing element 22 in relation to the pipe end 29" is brought to occupy the desired level.

As soon as the tool head 19 of the circulation equipment is centralized and height-positioned in relation to the coupling piece end 29" of the pipe 29 as explained above, representing a non-shown intermediate position between figure 3 and figure 4, i.e. a position wherein the tool head 19 occupies the position shown in figure 4 with regard to the coupling piece 29',29" of the pipe, but wherein the packing element 22 occupies an inactive, non-actuated position according to figure 3.

Therefore, reference is made to figure 3, imagining that the coupling piece of the pipe 29 - as shown in figure 4 - has entered the annulus 32 between guide jacket 19',19" and cylinder ring 21.

In the embodiment shown, the packing element 22 has the form of a freely suspended ring having a lower end surface 22' sloping complementarily to the slope of the upwardly conically tapering packing-actuating portion/surface 26" of the axially displaceable packing-actuating sleeve 26, against which the "free" end surface 22' of the packing element 22 rests supportingly in an inactive position of readiness, ready to be activated by means of the actuating portion 26", figure 3. In this position, the mantle surface of the packing element 22 is withdrawn radially internally of the largest radial extent of the guide head jacket 28 and will, thus, not interfere with the coupling piece 29' of the pipe 29 upon the insertion of the tool head 19 therein.

With the packing-actuating sleeve 26-26''' in the lower position of readiness shown in figure 3, hydraulic oil is supplied through the pressure oil channels 23,23' in guide

jacket 19',19" and cylinder ring 21, entering said (lower) second annulus 25, relieving the pressure within said (upper) first annulus 24.

This causes the packing-actuating sleeve 26-26''' to be displaced upwardly, in that the upwardly conically tapering actuating portion 26" through cooperation with the packing element's 22 inclined end surface 22' urges the lower "free" end portion of the packing element 22 radially outwards over the entire circumference, resting sealingly against the inner mantle surface of the pipe coupling piece 29', figure 4, whereafter the fluid-tight interconnection between the circulation equipment and the casing/conductor pipe has been established.

When one places in a new casing and the tool head 19 of the circulation equipment is pulled up from the last placed casing, the pressure within the lower casing is to be bled off. The pressure relief takes place in that the pressure is bled off via a channel 33 in the guide jacket 19',19" and in the cylinder ring 21 and a channel 33' in the packing-actuating sleeve 26-26''' .

In figure 1, the reference numerals 34-36 denote an adjustable pressure relief valve, a manometer and a stop valve, respectively.

Centrally within the lower bore portion of the end sleeve 18, a non-return valve has been mounted, the valve generally being denoted 37 and the individual components thereof appearing best from figure 3, wherein they are given reference numerals, said numerals being deleted from the other figures, partly due to small scale, partly due to uncomplete representation in figure 4.

Reference is now being made to figure 3 for the description

of the non-return valve 37, which is kept in place within the lower bore portion of the end sleeve 18 by means of a locking ring 38. Upon removal of the locking ring 38, the entire valve 37 may be removed.

The valve housing has been denoted 39 and has a central, axially through-going opening. The valve housing consists of two opposite oriented valve cones 40,40' screwed together by means of a screw 41. Between the valve cones 40,40', an annular packing 42 is clamped. The valve spindle 43 is guided in a sleeve 44, and between the valve body 40,40' and a flange on the guide sleeve 44, a pressure spring in the form of an ordinary screw spring 45 has been tensioned. Said guide sleeve flange is formed with axially through-going apertures 46. A locking ring 47 locks the guide sleeve 44 to the valve housing 39. Guide means for the upper valve cone 40 of the valve body 40,40', at the upper end of the valve housing 39, have been denoted 48.

The task of the non-return valve 37 is to close the liquid flow through the circulation equipment when it has been detached from the casing/conductor pipe and to prevent air/liquid from penetrating into the circulation equipment and further into the top drive.

The tool head 19 of the circulation equipment can be exchanged by loosening the locking screw 17 and thereafter neutralize the screwing between the end sleeve 18 and the intermediate piece 16.

Through the ports 14 (only one is visible in figure 1, yet several ports are imagined distributed in the circumferential direction) a purge medium may be conducted into the annulus 49 defined by the inner and intermediate pipes 2',3 of the hydraulic double-acting telescopic cylinder 2,2',3, in order to keep the mantle surfaces clean

so that an unhampered displacement possibility of the pipe 3 in relation to the concentrical stationary pipes 2,2' is secured.

The circulation equipment according to the invention comprises a number of individual parts, the function of which substantially should have appeared from the preceding description of the construction of the equipment. Some of these functions are repeated briefly in the following in connection with a statement concerning the mode of operation of the circulation equipment as a whole:

With the circulation equipment taking the outgoing position or position of readiness as illustrated in figures 1 and 3, wherein the equipment is imagined suspended from the top drive of the derrick (not shown) through the connector 1, and with the casing 29 positioned in an underlying, substantially coaxial position, the hydraulic telescopic cylinder 2,2',3 is first released at 9',10, whereafter the telescopic cylinder 2,2',3 is extended through a downward displacement of the pipe 3.

During the extension of the telescopic cylinder, the tool head 19 of the circulation equipment is guided centrally into the coupling piece 29' of the pipe 29 in a shock-absorbing way through the rubber-elastic cover 28 of the guide head 27, the annulus 32 between the cylinder ring 21 and the guide jacket 19',19" accommodating the mantle of the pipe coupling piece 29' . The upper edge 29" of the pipe coupling piece 29' may be observed visually through the window 20 of the guide jacket 19',19". When the desired mutual height location between the pipe end edge 29" and guide jacket 19',19" has been achieved, the hydraulic double-acting telescopic cylinder 2,2',3 is locked in that the locking pistons 8,9,9' is brought into engagement with the circumferential locking grooves 11 of the displaceable

pipe 3 of the telescopic cylinder.

Thereby, the tool head 19 ofthe circulation equipment will take the position shown in figures 2 and 4 in relation to the coupling piece 29' of the casing 29, whilst the packing element 22 and the packing-actuating sleeve 26-26''' - for the sake of the continued statement - is presupposed to take the position shown in figures 1 and 3, i.e. with the packing element 22 in non-expanded condition and the packing-actuating sleeve 26-26''' in non-activated position.

Now, the packing-actuating sleeve 26-26''' is activated, i. e. displaced upwardly, the packing-retaining cylinder ring 21 remaining stationary, whereby the upwardly conically tapering actuating portion 26" of the packing-actuating sleeve - while resting cooperatively against the opposing end surface 22' of the packing element 22 - urges the packing element 22 radially outwards over the entire circumference, so that it at a circumferential portion rests itself sealingly (fluid-tight) against the inner mantle surface of the pipe coupling piece.

Preferably, the packing element 22 is made from a material having elastic resilent properties. The nature of the material should in most operations be such that a withdrawal towards the outgoing position, figure 1 and 3, is secured as soon as the radially outwardly directed pressure from the surface 26" of the actuating sleeve 26 ceases. In principle, nothing prohibits the use of easily replaceable packing elements 22; the retainment within the circumferential groove 21' of the cylinder ring 21 not having to be permanent. On the contrary, often a loose, frictiondetermined engagement between the walls defining the circumferential groove 21' and the attachment portion 22' of the packing element 22 would be preferred.

Thus, the intentional sealing interconnection between circulation equipment and casing/conductor pipe 29 has been established, and the circulation of e.g. concrete, mud, diesel oil or water may be started.

When circulation of e.g. mud through pipe 29 and bore hole is interrupted, the circulation pressure is relieved, whereafter the packing element 22 is deactivated and returns to it outgoing position, figures 1 and 3.

When the circulation pressure is relieved, the spring-loaded 45 non-return valve 37 will secure that the circulation/ purge medium contained within the circulation equipment does not leak out, but rather remains contained within the axial bore 15 of the equipment.

Thereafter, the tool head 19 of the circulation equipment is pulled up and away from the coupling piece 29' of the casing/conductor pipe 29 in that the displaceable pipe 3 of the hydraulic telescopic cylinder 2,2',3 is pushed back to the position of readiness shown in figure 1, more particularly after neutralizing the locking at 9',11, the pipe 3 of the telescopic cylinder thereafter being locked in a new position at 9',10, corresponding to the contracted or shortened condition of the telescopic cylinder 2,2',3.

As defined previously, the inner parts of the telescopic cylinder 2,2',3 may be cleaned in extended as well as in contracted condition. Cleaning/purging may take place by means of fresh water, diesel oil or the like. Purge ports 14 (one is visible in figure 1) can be brought to register with ports of a manifold (not shown) which is coupled to a purge hose upon cleaning.

C l a i m s

1. A circulation equipment for the purging of predrilled oil or gas wells upon setting of casings and conductor pipes, said circulation equipment preferably being designed to be suspended from the top drive of a derrick, substantially axially aligned with the underlying casing or conductor pipe (29) to be set, c h a r a c t e r i z e d i n that the circulation equipment comprises an elongated, substantially tubular body having a through-going axial bore (15)extending from one axial end thereof to the other, said tubular body at the lower end thereof carrying a tool head (19) adapted for sealing interconnection with the coupling piece (29') of said casing/conductor pipe (29), wherein the tool head (19) exhibits a downwardly open annulus (32) for the accommodation of said pipe coupling piece (29') and, in the area of said annulus (32), a radially expandable packing element (22) which, in expanded condition, is shaped and adapted to rests itself sealingly against the inner surface of said pipe coupling piece (29'), along the entire circumference thereof.

2. A circulation equipment according to claim 1, c h a r a c t e r i z e d i n that said downwardly open annulus (32) is defined between a sleeve-shaped or tubular body (21) and a guide jacket (19',19") surrrounding the latter, said sleeve-shaped or tubular body (21) retaining the radially expandable packing element (22), in that a axially displaceable packing-actuating sleeve (26) which is arranged radially inwardly of the sleeve-shaped or tubular body (21), is formed with an actuating surface (26") for radial expansion of the packing element (22) upon the axial displacement of the actuating sleeve (26).

3. A circulation equipment according to claim 2, c h a r a c t e r i z e d i n that the packing element

(22) has the form of a ring having an upper attachment portion (22'') in the position of use, said attachment portion (22') being accommodated within a downwardly open circumferential fastening groove (21'), of the sleeve-shaped or tubular body (21), the lower edge portion (22') being substantially freely suspended.

4. A circulation equipment according to claim 2 or 3, c h a r a c t e r i z e d i n that the packing-actuating portion/surface (26") of the axially displaceable packing-actuating sleeve (26) extends upwardly conically tapering, and that said substantially freely suspended lower edge portion (22') of the packing element (22) is chamfered (inclined surface 22') complementarily to the packing-actuating surface (26"), so that the chamfered end surface (22') of the packing element (22) may rest supportingly against the packing-actuating surface (26"), in the packing element's (22) non-expanded condition as well as in its expanded condition, so that a certain guide function is achieved during the movement of the packing element (22), especially from non-expanded to expanded condition.

5. A circulation equipment according to one or more of the preceding claims, c h a r a c t e r i z e d i n that the packing element (22) is made from a material of such a nature, preferably exhibiting elastic resilient properties, that that packing element (22) automatically will tend to return to non-expanded position of readiness as soon as the activating force from the packing-actuating sleeve (26) has been brought to cease.

6. A circulation equipment according to any one of the claims 2-5, c h a r a c t e r i z e d i n that between an inner end sleeve (18) incorporated into the tool head (19) of the circulation equipment and said sleeve or ring body (21), which is arranged radially outwardly of the end

sleeve (18), an annulus (24,25) has been defined, wherein the packing-actuating sleeve (26) has been arranged with limited axial displaceability, and that within said sleeve or ring body (21) and said guide jacket (19), channels (23, 23') have been formed for the supply/removal of pressure fluid to/from said annulus (24,25) above and below the packing-actuating sleeve (26), respectively.

7. A circulation equipment according to any one of the claims 2-6, c h a r a c t e r i z e d i n that said guide jacket (19',19") is formed with a radially through-going opening (20) constituting a window, through which it visually may be observed where the upper end edge (29") of the coupling piece (29') of the casing/conductor pipe (29) is situated in relation to the level of the tool head (19).

8. A circulation equipment according to any one of the preceding claims, c h a r a c t e r i z e d i n that into the elongated, substantialy tubular body of the equipment is incorporated a double-acting pressure fluid operated telescopic cylinder (2,2',3) which is lockable in at least two extreme positions, said telescopic cylinder (2, 2',3) is situated between an upper connector (1) and the lower tool head (19) of the equipment, possibly through the intermediary of sleeve-shaped/tubular components (16,18).

9. A circulation equipment according to claim 8, c h a r a c t e r i z e d i n that the connector (1) of the equipment is constituted by a short sleeve ring-shaped connector (1) screwed to the upper end of the telescopic cylinder (2,2',3).

10. A circulation equipment according to claim 6, c h a r a c t e r i z e d i n that within the end sleeve (18) of the equipment is mounted a non-return valve (37) adapted to prevent leakage of circulation/purge medium

from the circulation equipment upon relieved pressure.

1/4

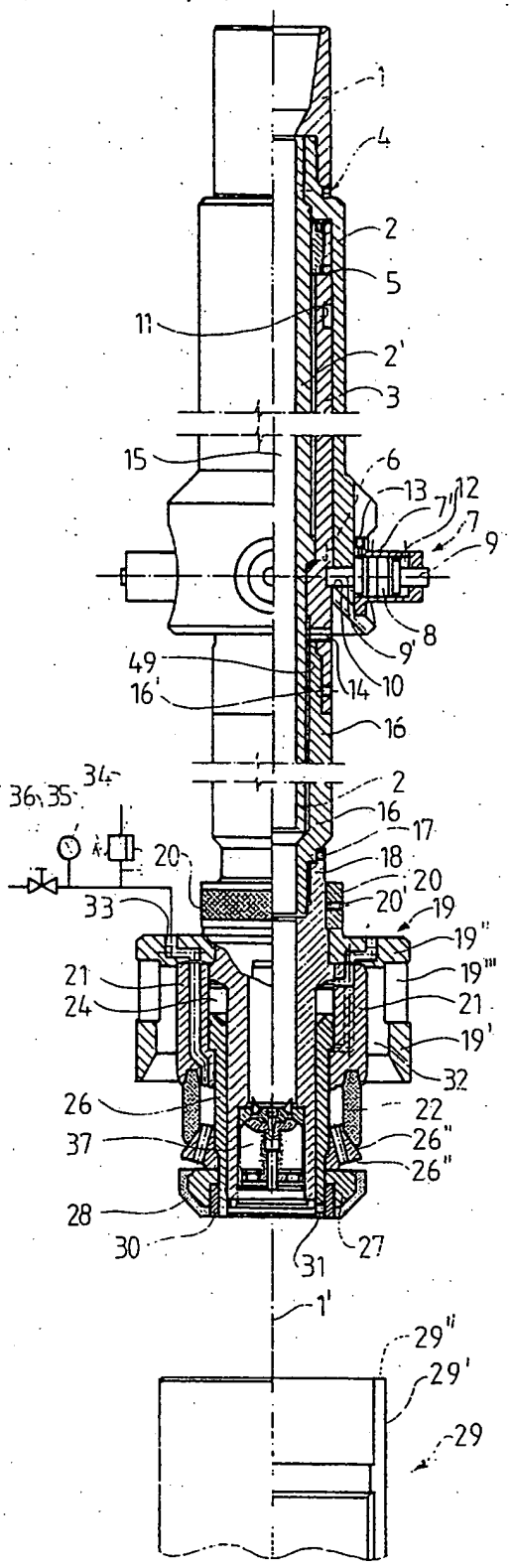

1
4
2
5
11
2'
3
15
6
13
12
7'
7
9
8
9'
49
16'
14
10
16
36
35
34
2
16
17
18
20
20'
19
19''
19'''
21
24
21
19'
32
26
22
37
26''
26''
28
30
31
27
1'
29''
29'
29

Fig.1

2/4

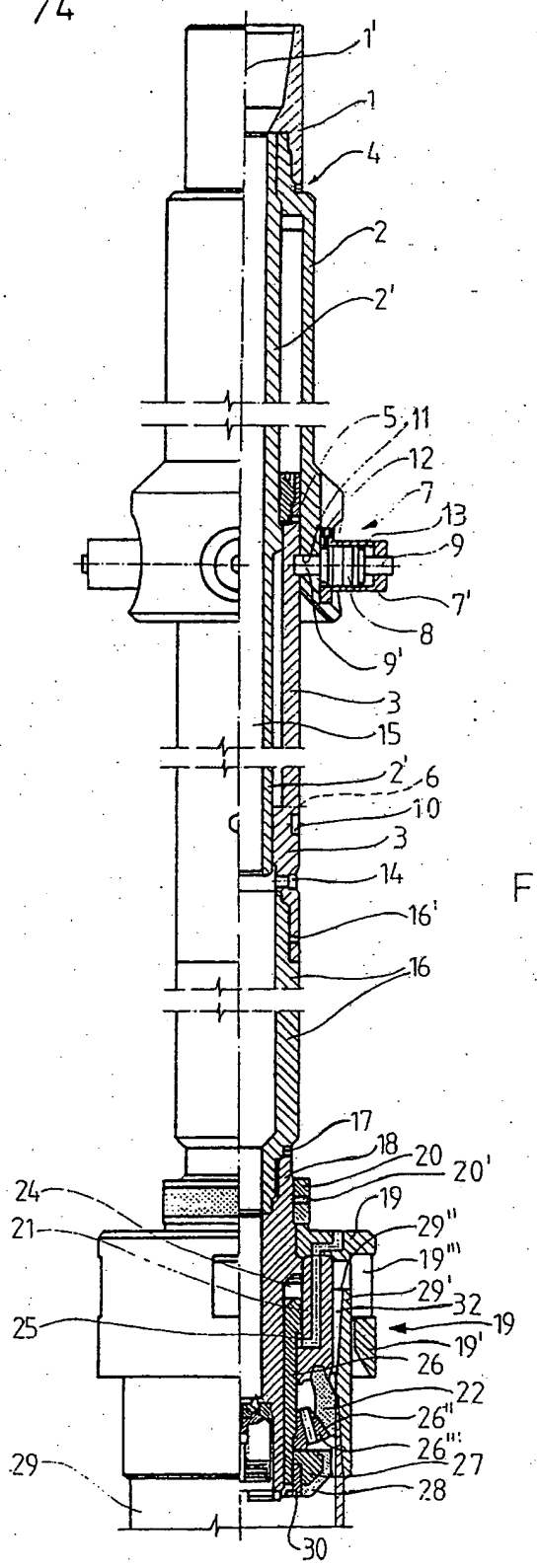

1'
1
4
2
2'
5,11
12
7
13
9
7'
8
9'
3
15
2'
6
10
3
14
16'
16
17
18
20
20'
19
29''
19'''
29'
32
19
19'
26
22
26''
26'''
27
28
30
24
21
25
29

Fig.2

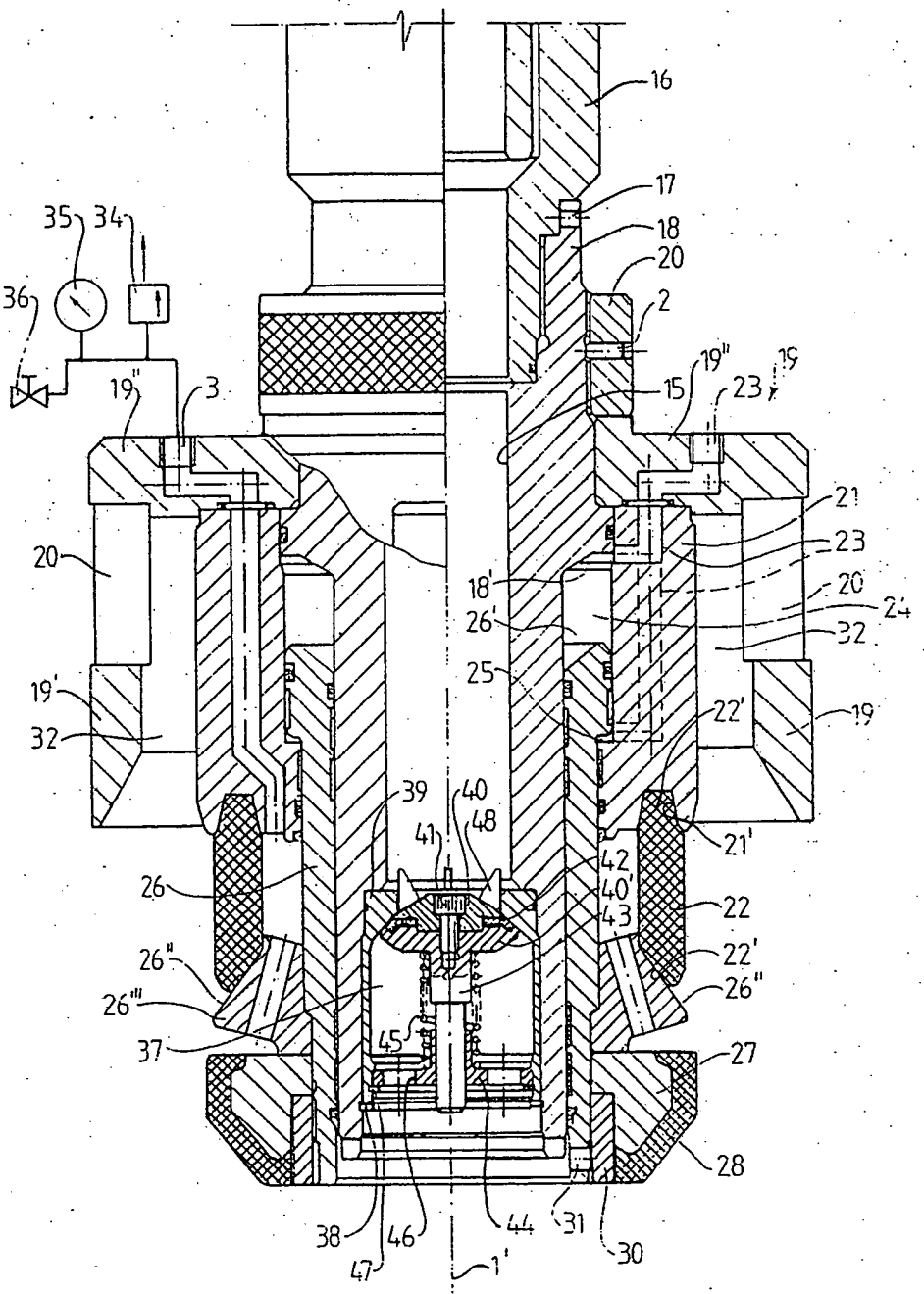

16
17
18
20
2
35
34
36
19"
3
15
19"
23
19
21
23
20
18'
20
24
26'
32
25
19'
32
22'
19
39
40
41
48
21'
42
26
40'
43
22
26"
22'
26"
26"'
37
45
27
28
38
46
44
31
30
47
1'

Fig.3

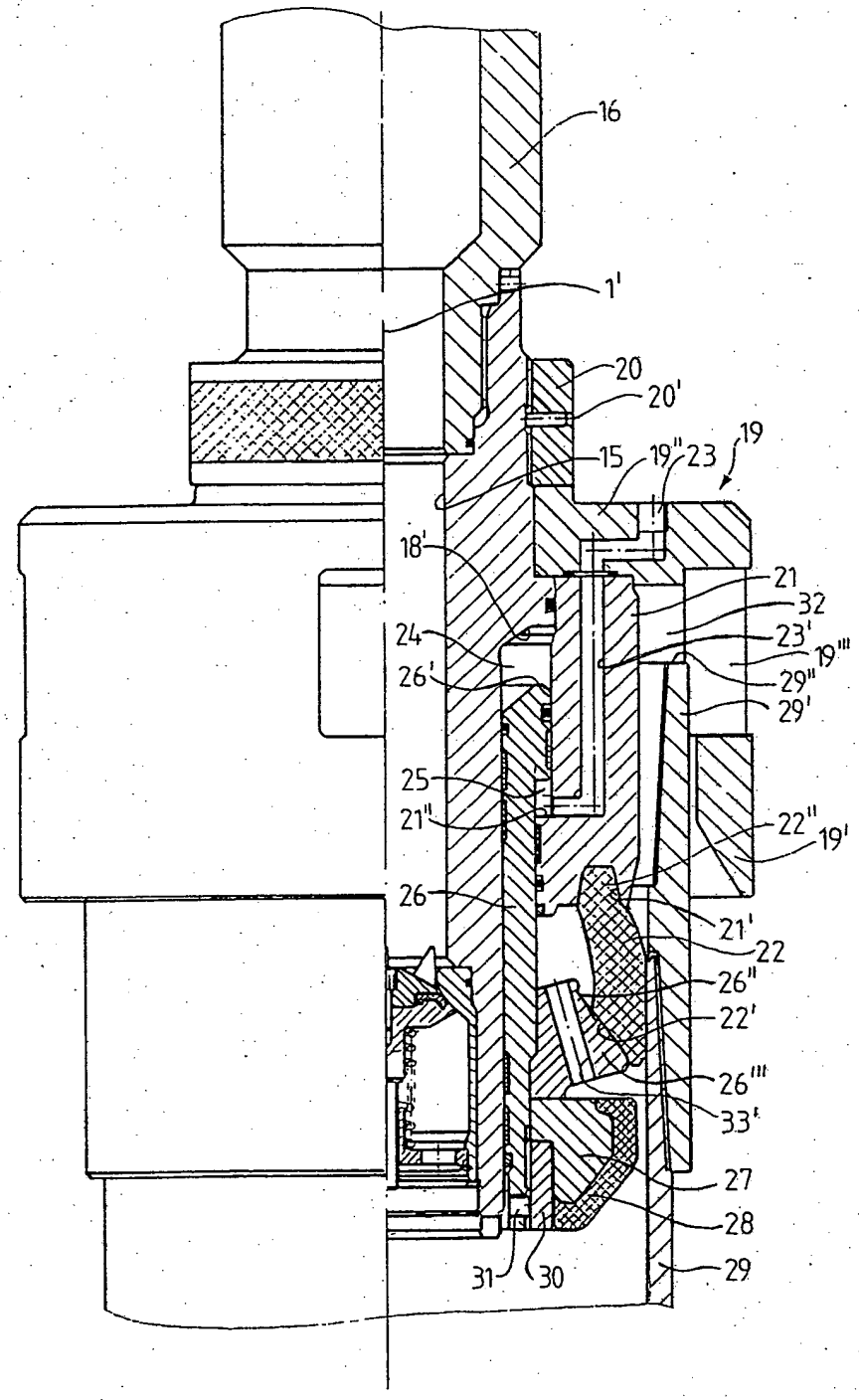

16
1'
20
20'
19
15
19''
23
18'
21
32
24
23'
19'''
26'
29''
29'
25
21''
22''
19'
26
21'
22
26''
22'
26'''
33'
27
28
29
31
30

Fig.4

INTERNATIONAL SEARCH REPORT

International Application No PCT/NO 92/00157

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: E21B 37/00, 21/00

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	E21B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	WO, A1, 9000668 (PHOENIX PETROLEUM SERVICE LTD.) 25 January 1990, see page 1 - page 5 the figures --	1-10
A	WO, A1, 9114076 (UNGEMACH, P. ET AL) 19 September 1991, see the whole document --	1-10
A	EP, A2, 0427424 (HALLIBURTON COMPANY) 15 May 1991, see column 1 - column 3 the figures --	1-10

---

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
5th January 1993	11 -01- 1993
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Christer Bäcknert

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/NO 92/00157

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 02/12/92
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A1- 9000668	90-01-25	NONE		
WO-A1- 9114076	91-09-19	FR-A-	2659384	91-09-13
EP-A2- 0427424	91-05-15	AU-D-	6465290	91-05-16
		CA-A-	2029530	91-05-09
		CN-A-	1052166	91-06-12
		US-A-	4991653	91-02-12